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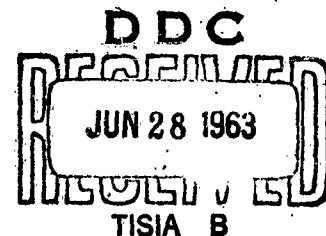
BIOGRAPHY OF A MASER-RESEARCH SCIENTIST

by Ryszard Dyja

- Poland -

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BIOGRAPHY OF A MASTER-ENGINEER OUTPOST

- Poland -

[Following is a translation of an article by Ryszard DYJA in the Polish-language illustrated weekly Zolnierz Polski (Polish Soldier), Warsaw No 8 (769), 24 February 1963; pp 16-17.]

He talks about himself in a dispassionate manner; as if there were nothing sensational in everything he says. He is terse and exact, mathematically exact, when relating the events of his life in chronological order.

I am looking at my notes again, in order to recapture my impression of him. This man's biography reads like a statistic; and yet it is not a stereotype story.

"I was born in 1929 in Wilno into a cobbler's family. At thirteen I worked on my first job, father being in captivity. I became a worker in a factory of farm machinery. After the war we moved with my whole family to Gdansk. Here I worked in the harbor as a longshoreman. I went to evening school. A year later I was promoted to a clerical position with "Spolem" [cooperative]. I graduated as an external student, and then first applied for admission to the Academy of Medicine in Gdansk. After having passed the entrance examination, I changed my mind and took another examination - this time for admission to the Technical University. In three years I received my Engineering Degree. I arrived in Warsaw to work at the Military Engineering Academy. I started out as an assistant, but after several months conducted already my first lectures. I wrote my Master's Thesis and also received my Doctorate"

This is the "census-like" life story of Major Zbigniew PUZEWICZ, Doctor of Engineering.

I would like to review the details of his life; surely the reader will not be bored. I shall emphasize at what age the important events occurred and also add my brief commentary.

Thirteen years old - worker in a factory of farm machinery. War. Normal education is out of question. Only reading at night is still possible. He reads everything he can

get hold of.

Sixteen years old - continues working. After the liberation of the fatherland, he becomes a guard with the plant police. At the same time he makes up for the lost years of schooling. Reading is still his passion. He later recalls that knowledge gained from books gave him a big advantage over others of his age. In school he passes from grade to grade with greater ease and he does it at an accelerated pace.

Seventeen years old - he still works as a laborer. This time he is a longshoreman in the Gdansk harbor. Evening courses for working people are given at the high school. He also reads constantly; every free moment is spent with a book.

Eighteen years old - promotion: he becomes a clerk in "Spolem" cooperative. He studies evenings.

Nineteen years old - change of job. The bureaucratic merry-go-round brings him into the Treasury Department in Gdansk. "This must be where he learned to count so well" remarks a colleague, while Major Dr. PUZEWICZ reminisces about those times of thirteen years ago. PUZEWICZ maintains he never encountered any serious difficulties in physics and mathematics. Nevertheless, he chooses a medical career and is admitted to the Gdansk Academy of Medicine.

Nineteen years old - sudden change of interests. He decides on taking another entrance examination. The Technical University is his choice now.

From nineteen to twenty-two - studies. He belongs to the Military Academic Company, which assures him of a scholarship. He must, of course, help his family.

Twenty two years old - an engineer already, he begins to work as assistant and lecturer at the Military Engineering Academy which is being established in Warsaw.

Twenty six years old - continues working at the Military Engineering Academy. He writes his Master's Thesis.

Thirty years old - receives his Doctorate. Topic of the dissertation is: Transmission of Electromagnetic Energy in the Microwave Range.

Thirty two years old - holds a high and responsible position at the Military Engineering Academy.

Thirty three years old - directs all work on Quantum Amplifiers - Masers.

Now, ladies and gentlemen, we are beginning to deal with highly scientific matters; and furthermore, it all has to do with mathematics. If, at least, it were simple mathematics; but not even that.

I would not even try to explain something like quantum mechanics in layman's terms. Please, take my word for it when I say that the science of quantum mechanics is a certain

branch of mathematics. I have seen the practical use of it in the Maser installation mentioned before, or rather in the huge number of Maser components.

This then is Maser:

Do you remember the signals transmitted by Sputniks and received on radio and television? Right here, on our beloved Earth, these signals are detected by a device of the Maser type. They are transmitted from the interplanetary station "Mars 1" which had been launched from Earth. Although millions of kilometers away, people on Earth are able to receive its message. Maser has made this possible. "Tel-Star" transmitting television pictures from Europe to the other continent or vice versa would be just another artificial satellite without Maser.

In short, Maser means signal reception from outer space. Such device can detect signals transmitted over waves of very short length: only a few centimeters or even millimeters. Cosmic signals are hardly audible. Maser amplifies those signals without introducing any noise of its own (unlike other amplifiers used before). Thus, Maser means communication (reception) over those immense cosmic distances.

We know, that Masers have been built in the Soviet Union and in the United States, perhaps also in Great Britain. We know, that installations of this type are being developed in two or maybe three European countries. It is known, that we, too, have a Maser: at the Military Engineering Academy. And the thirty three years old Major Dr. Zbigniew PUZEWICZ is one of its builders - he insists that this is a group project.

...A large bright room is filled up with all kinds of instruments, an array of metal tubes and conduits twisted into most peculiar shapes. There is a giant ice-refrigerator in which the temperature is maintained below -60°C . There is liquid oxygen which hardens immersed objects like steel. There is liquid nitrogen which, when spilled on the floor, evaporates as if touched by a magic wand. There are electromagnets and also ... rubies. These rubies are most genuine but synthetic. They are wrapped carefully in cotton wool and placed in an ordinary carton, although their value amounts to many thousand zlotys.

There can be no Maser without rubies, because indeed a ruby is the heart of the Maser.

"The ruby gave us most trouble", says Major Dr. PUZEWICZ. "The ruby in a Maser plays the role of an electron tube. The aluminum smelting plant in Skawina came to our aid. They developed a technique for producing synthetic rubies. They actually produced them, while we were the first in Poland to determine the microwave characteristics of this mineral. Then

emerged the next problem: the grinding of rubies, followed by ten, hundred, even thousand - without exaggeration - new problems. To-day this is a memory only, a pleasant memory; but not more than a few weeks ago a persistent struggle was taking place in this laboratory. We fought over the influence of environmental factors on the structure of matter, over the forcing changes in the internal structure of matter, and over ... concocting a few centimeter long tube of rare metal alloys.

"Something earthy at last" I thought, when my interlocutor was telling me about this modest small tube which does not even dream about some structure of matter or utilization of quantum phenomena, about atoms or complicated formulae. Alas, disappointment was in store for me: it appears, that everything on our beloved planet Earth is subject to calculations - even a nice piece of metal.

Similar circumstances prevailed during the development of the already mentioned apparatus by young scientists of the Military Engineering Academy.

Maser is the result of a year's work by a large collective. During those 360 days, work did not always stop after eight or ten hours, and nights were not always spent on sleep. Typical is a statement by Major Dr. PUZEWICZ: "We completed the last four months of research in two months". When everything was almost ready, when the Maser was expected to "move" any moment now - the cloud of doubt suddenly descended upon the team. One of the countless Maser components failed to respond, with unusual stubbornness. Hundreds of tests were made. The scientists forgot all about days and nights, forgot their families. So it went on for over ten days. Then suddenly Dr. PUZEWICZ decided: "If the system does not respond to-day, I will go to sleep".

The system responded. And naturally nobody, including the hero of our story, went to sleep. They began to conduct further experiments....

Captions under pictures :

- 1) at the Maser installation
- 2) Maser operates at very low temperatures
- 3) synthetic rubies - the heart of Maser

MASER AND WHAT IS IT ?

In 1958, the first Radar echo from the planet Venus was successfully received back. The intensity of this reflected signal was enormously small; it amounted to a fraction of a watt, a fraction whose numerator was one and its denominator was ten to the 27th power, (that is one watt must be divided by a billion, once more by a billion and once more by a billion). The detection of such terribly weak signal was made possible thanks to a new type of amplifier, the Maser.

In the application of conventional -tube or transistor-amplifiers there existed a limit beyond which the amplification of weak radio signals became entirely impossible. Noise and interference generated in the amplifier equipment superimposed on the signal to be amplified did not permit the detection of the latter. In the Maser, which—in simplified terms—consists of a ruby immersed in liquid helium, such noise does not appear. The operation of a Maser is based on "resonance" of electrons in the atom moving from an outer shell to an inner shell, under the influence of radio signals of certain wavelength. These electrons, while jumping, generate many times more energy than they absorbed before leaving their original, outer orbit.

The atoms of certain elements have many electrons orbiting in the outer shell. In order to prevent these electrons from escaping, for which they exhibit a strong tendency, it is necessary to hold them by some means. This was accomplished through freezing. For this reason Maser operates at very low temperatures of the order of -200°C . The crystal of aluminum oxide, popularly known as ruby, has been recognized as most suitable for the amplification of weak signals.

The signal to be amplified is indeed conducted over a special cable to the ruby immersed in liquid helium. This signal impinges on the outer layer of electrons and causes them to jump over into an inner orbit. The energy released in this process is of the same wavelength as that of the incoming signal. This energy, already in the form of a highly amplified signal, leaves the Maser through another conduit. A regenerative current flows into the Maser through a third line, that is electrons seem to be pumped back from the inner orbits into the outer one.

A few examples will convey the vast potential which Maser offers in bringing about a revolution in the field of electronics. Maser will make it feasible to receive signals from Venus broadcast by a less than 9-watts powerful transmitter; from the moon - a nine millionths of a watt will suffice; and from Mars only a 4-watt transmitter needed to radiate signals into space. For comparison: the Rasyn radio station has the power of 500 kilowatts.

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